VI.14 Direct Utilization of Coal Syngas in High Temperature Fuel Cells

Objectives

- Identify the fundamental mechanisms of carbon deposition and sulfur poisoning on anodes.
- Develop novel materials to minimize the impact of contaminants on fuel cell performance.
- Characterize the effects of major trace contaminants found in coal syngas.
- Propose remedies for adverse effects of contaminants on fuel cell performance.

Accomplishments

This project has been selected for funding under the DOE EPSCoR (Experimental Program to Stimulate Competitive Research) State Implementation Grant Award Program and will begin conducting research in the fall, 2006. There are no accomplishments to report at this time.

Introduction

This project is supported under the DOE EPSCoR, a program designed to enhance the capabilities of EPSCoR states in energy research and economic development through the support of advanced research at academic institutions. Our vision is to establish an internationally recognized, sustainable fuel cell research center for coal-based clean power generation which serves as a technology resource for the emerging fuel cell industry in West Virginia. Our strengths are in applying nano-technology to develop and fabricate materials for advanced coal-based fuel cells; establishing a state-of-the-art material characterization and fuel cell testing laboratory; and modeling fuel cells from atomistic to continuum scales using high performance computing. We have formed a multidisciplinary team of eleven research professionals who have worked together for several years and have strong credentials in their respective areas of expertise. Under the present proposal, we will develop a laboratory infrastructure, solidify interactive working relationships, and attain national recognition for the work conducted by the center in the area of coal-based clean power generation via fuel cells. Our project will be conducted in collaboration with the National Energy Technology Laboratory (NETL). This project is to be funded for a 3-year effort.

Richard Bajura, WV DOE EPSCoR Principal Investigator, Ismail Celik, Technical Principal Investigator

National Research Center for Coal and Energy
West Virginia University
385 Evansdale Drive
Morgantown, WV 26506-6064
Phone: (304) 293-2867 Ext. 5401; Fax: (304) 293-3749
E-mail: bajura@wvu.edu

DOE Project Manager: Kristin Bennett
Phone: (301) 903-4269
E-mail: Kristin.Bennett@science.doe.gov

DOE Technical Manager: Lane Wilson
Phone: (304) 285-1336
E-mail: Lane.Wilson@netl.doe.gov

Approach

The focus areas for the proposed research project are the modeling, manufacture, and testing of anode materials for solid oxide fuel cells (SOFCs) operating on coal syngas (CSG). The objectives are to identify the fundamental mechanisms of carbon deposition and sulfur poisoning on the anode, and to develop novel materials to minimize the impact of these contaminants on fuel cell performance. We shall also characterize the effects of major trace contaminants found in CSG and propose remedies for adverse effects.

DOE EPSCoR requires that research funded under the State Implementation Grant Program be conducted as a coordinated effort involving clusters of investigators focusing on specific projects. An overview of the cluster program is shown in Figure 1. The research cluster is based on a multi-scale, multi-disciplinary approach conducted by nine faculty members in four departments at West Virginia University (WVU). The work is organized under four integrated projects: (1) anode material development and experimental characterization of fuel cell anodes, (2) sub-micro-scale modeling, (3) multi-scale continuum modeling, and (4) laboratory testing of individual fuel cells and fuel cell systems.

The strength of the research cluster is in the integration of knowledge obtained from experiments (Projects 1 and 4) with multi-scale computational models (Projects 2 and 3). At all stages, information, predictions, and data will be exchanged between researchers in the projects.

At the end of three years, we anticipate four outcomes. First, we will have identified the fundamental processes characterizing the operation of

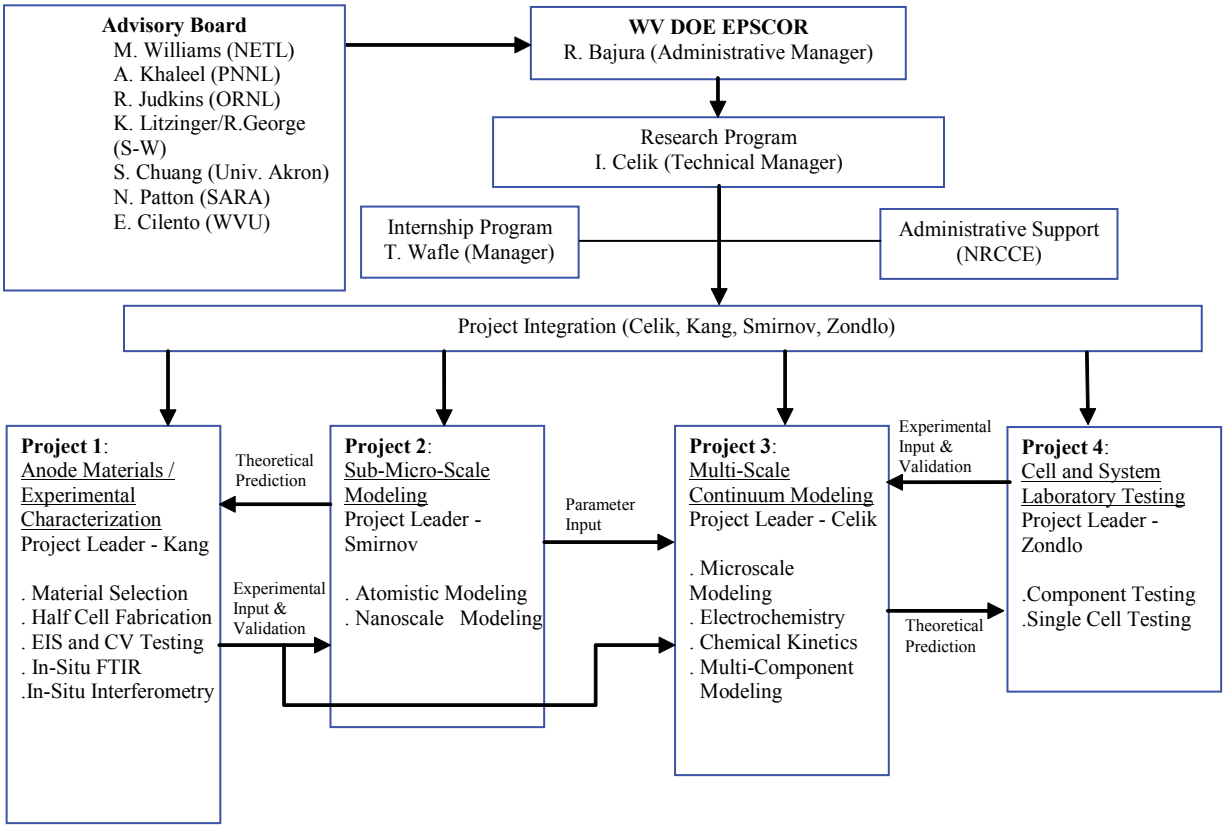

FIGURE 1. Flow Chart of the Research Program and Organizational Structure.

SOFC anodes from the atomic level to the level of the operating fuel cell. Second, strategies will be developed for constructing SOFCs that exhibit stable operation with coal syngas. Third, the research infrastructure (equipment for analysis and for fabrication, computers for modeling) and collaborations across disciplines and departments at WVU will be well developed for future research on fuel cells. Fourth, a program of educating and training future energy researchers will be established.